

Analysis of Mandibular Fractures: A 7-year Retrospective Study

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Abstract

Background: Mandibular fractures contribute to a substantial proportion worldwide. Various variables related to mandibular fractures such as demographics, etiology, pattern of fracture, and treatment have been studied, but fewer reports on their correlations are published. Hence, this study attempts to understand these factors which can be useful for setting up clinical and research priorities. **Aim:** The purpose of this retrospective study is to establish a correlation between different factors associated with mandibular fractures. **Materials and Methods:** A database of 277 patients between July 2011 and October 2018 with mandibular fractures was retrospectively retrieved. Information on age, gender, etiology, pattern of fracture, and treatment done was obtained, tabulated, and analyzed statistically. Entities such as age and gender, age and cause, gender and cause, site of fracture and cause, site of fracture and side, site of fracture and treatment done, and site of fracture and gender were correlated. **Statistical Analysis Used:** Descriptive and analytical statistics were calculated using the SPSS version 20 using Chi-square tests which include Pearson's Chi-square and likelihood ratio. **Results:** In a total of 277 patients, a statistically significant correlation was found between age and the etiologic agent, site and side of fracture, and site of fracture and the treatment done with value of $P < 0.05$. **Conclusion:** A definite correlation between multitude of overlooked relevant co-factors has been studied which can provide an operating surgeon, a valuable impetus to be more vigilant in terms of medicolegal record maintenance, diagnosis, and possible clinical strategy for the treatment of mandibular fractures.

Keywords: Incidence, mandibular fractures, pattern, trauma

INTRODUCTION

In the entire human body, the maxillofacial area is injured quite frequently. In it, the second most often fractured adult facial bone is mandible because of its projecting and vulnerable position in the face.^[1] Mandibular fractures comprise 15.5%–59% of all maxillofacial fractures.^[2]

Several variables are related to the study of mandibular fractures which have resulted in differences in demographic characteristics reported in the literature. Various countries across the globe have provided statistics of mandibular fractures, but information provided is distinct for the countries of origin and the people residing there.^[3] Increase in incidence of mandibular fractures is stated in long-term studies. Reported data show that mandibular fractures occur usually in the third decade of life with male predominance.^[4] The socioeconomic trends, geographic locations, and local behavior have a considerable impact on the etiology of the injury which sequentially influences the distribution of fracture sites.^[5] The

key etiology for maxillofacial fractures may vary from road traffic accidents to assaults and from fall to sports injuries. Most mandibular fractures which occurred from assault have alcohol consumption as an eminent contributing factor.^[6]

No unanimity has been found for the common pattern of mandibular fractures because of disparate factors associated such as geographic area, population mass, socioeconomic status, regional government, cultural factors, educational status of the population studied, and political era.^[7]

Owing to these attributes, this article aims to analyze retrospectively the age and gender distribution, etiology,

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anatomic distribution, treatment provided, and their correlation in patients who visited Ahmedabad Municipal Corporation Dental College and Hospital, Ahmedabad, Gujarat, India, from July 2011 to October 2018.

The purpose of our study is to assess different factors associated with mandibular fractures such as incidence, pattern, etiology, and management and to establish its correlation in patients who reported to this tertiary hospital.

MATERIALS AND METHODS

The records of maxillofacial injury patients who reported to the Department of Oral and Maxillofacial Surgery, Ahmedabad Municipal Corporation Dental College and Hospital, Ahmedabad, Gujarat, from July 2011 to October 2018 were retrieved from hospital database. A retrospective study was conducted where records of patients having isolated mandibular fractures were sorted out. The data of 277 patients with isolated mandibular fractures were assembled which included case history, radiographs, photographs, clinical notes, and operative notes. The records were analyzed and tabulated according to age, sex, etiology of the fracture, anatomic location (based on the Dingman and Natvig classification^[4]), side of fracture, pattern of fracture, and treatment (by open or closed reduction). Those patients who had associated maxillofacial fractures and comminuted mandibular fractures, who did not undergo any treatment, and whose records were incomplete or missing were excluded. In few cases, the possibility of patients giving untruthful history with regard to the etiology of the trauma was clearly noticeable. Furthermore, at times, patients later confessed the deliberate distortion of their history due to unfavorable circumstances. These patients, including those who arouse our suspicion, were specifically referred for psychological counseling. On the basis of the retrospective observational nature of study and exclusion of patients' private personal information from the dataset, this study was granted exemption from the institutional review board for further review.

Ethics

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments (2000) or comparable ethical standards. Patients' names, initials, or hospital numbers are not used.

Statistical analysis used

Descriptive and analytical statistics were calculated using the Statistical Package for the Social Sciences (SPSS) version 20 (IBM company, Armonk, New York, US). The Chi-square test was used to find statistical significance between two variables. If $P < 0.05$, then two variables were in correlation with each other.

RESULTS

A total of 363 mandibular fractures were treated in 277 patients during the study period in our department. The mean number of fractures per patient was 1.3.

Demographic data of patients

Of 277 patients, 222 (80.14%) were male and 55 (19.9%) were female. The ratio of males to females came out to be 4.03:1.

Patients' age ranged from 5 years to 78 years (mean = 39.5 years), with the highest number of mandibular fractures in 21–30 years' age group ($n = 114$, 41.2%) and least in 0–10 years' age group ($n = 9$, 3.2%).

In males, the peak age group was 21–30 years ($n = 93$, 41.9%), followed by 31–40 years ($n = 40$, 18.0%), whereas in females also, it was 21–30 years ($n = 21$, 38.2%), followed by 31–40 years ($n = 12$, 21.9%) [Graph 1].

Etiology

The most common cause of mandibular fractures was road traffic accidents ($n = 132$, 47.7%), followed by fall ($n = 86$, 31.0%), assault ($n = 51$, 18.4%), sports ($n = 6$, 2.2%), and others ($n = 2$, 0.7%).

In males, road traffic accidents were the most frequent etiology ($n = 105$, 47.2%), followed by fall ($n = 72$, 32.4%). In females, the most common cause was road traffic accidents ($n = 27$, 49.1%), followed by assault and fall ($n = 14$, 25.4%).

Road traffic accidents were the most common etiology in patients with the age range of 21–30 years. This relation between age group of patients and etiology was found to be statistically significant (Chi-square value = 0.016, $P < 0.05$) [Table 1].

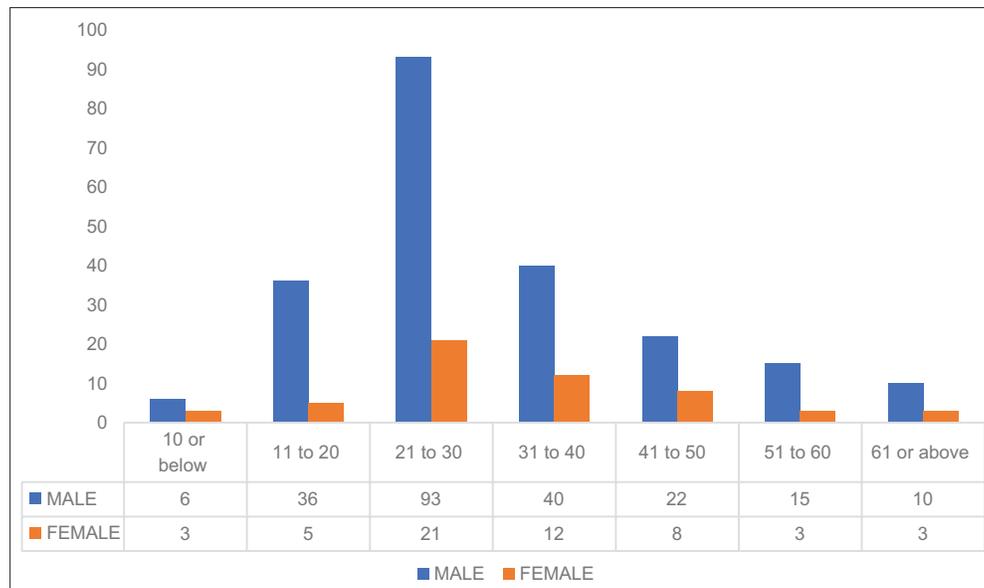
Anatomical distribution

The series of single fracture site from most common to least common was dentoalveolar fractures ($n = 73$, 26.4%), parasymphysis ($n = 34$, 12.3%), body ($n = 29$, 10.5%), angle ($n = 24$, 8.7%), condyle ($n = 18$, 6.5%), symphysis ($n = 12$, 4.3%), and ultimately ramus ($n = 3$, 1.1%). No coronoid fracture was seen in our study.

Table 1: Relation of age group and etiology of fractures

Age group	Etiology					Total
	RTA	Falls	Assault	Sports	Others	
<10	2	5	1	0	1	9
11-20	14	19	5	3	0	41
21-30	58	26	27	3	0	114
31-40	28	17	6	0	1	52
41-50	17	9	4	0	0	30
51-60	7	6	5	0	0	18
61 or above	6	4	3	0	0	13
Total	132	86	51	6	2	277

RTA=Road traffic accident



Graph 1: Relation of gender of patients with their age range

Overall, there was no major difference in the side of fracture site (left: 97, 35.0%; right: 96, 34.7%). Dentoalveolar fractures of the right side were the highest which was statistically significant (Chi-square value = 0.00, $P < 0.05$) [Table 2].

On clinical observation, road traffic accidents caused dentoalveolar fractures ($n = 30$, 22.8%), followed by parasymphysis fractures ($n = 20$, 15.1%). Falls also resulted in dentoalveolar fractures ($n = 29$, 33.8%), followed by parasymphysis ($n = 9$, 10.4%). Assault resulted in more of dentoalveolar fracture ($n = 18$, 25.4%).

Frequency of single and multiple mandibular fractures

When 277 patients with mandibular fractures were evaluated, there were 193 patients with single fractures (69.7%); 84 patients had fracture at more than one site (30.3%).

Clinical observation suggests that dentoalveolar fractures ($n = 73$, 26.4%) were the most common among single-site fractures whereas parasymphysis and condyle combination ($n = 21$, 7.6%) was the most common site in cases of multiple fractures [Graph 2].

Management

In this study, closed reduction was done in 150 (54.2%) patients, of which highest were in dentoalveolar fracture cases (46.7%). Open reduction and internal fixation was performed in 127 (45.8%) patients with highest in cases of parasymphysis fractures (18.1%), whereas in patients with fracture at more than one site, open reduction and internal fixation was maximally done in cases of parasymphysis and condyle (12.6%). These relations between site of fracture and treatment performed were statistically significant (Chi-square value = 0.00, $P < 0.05$) [Table 3].

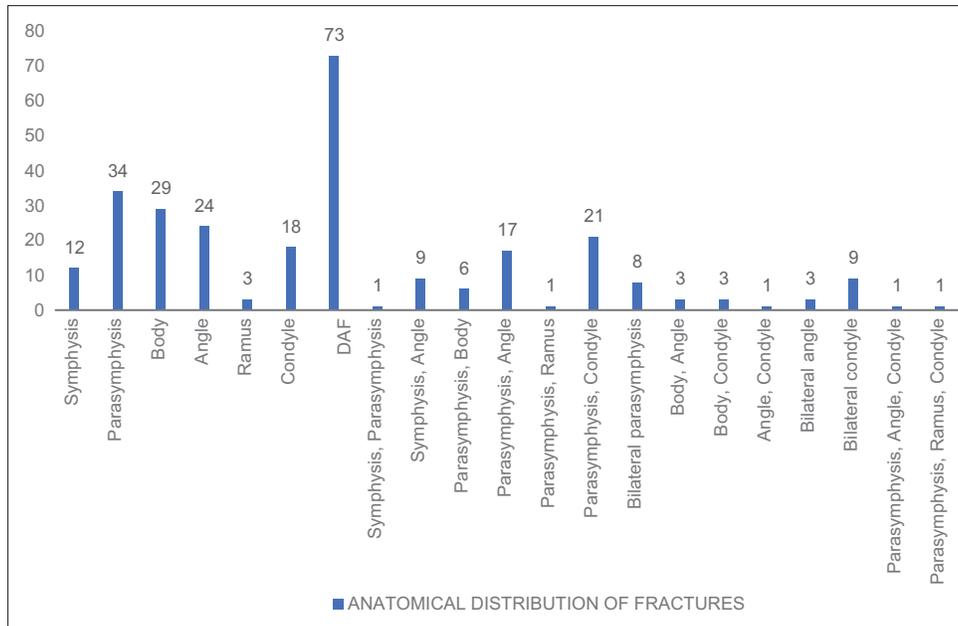
DISCUSSION

The purpose of conducting this retrospective study is that while dealing with trauma cases having possible medicolegal issues,

Table 2: Association between site and sides of fractures

Site of fracture	Side of fracture				Total
	Both	Left	Midline	Right	
Symphysis	0	0	12	0	12
Parasymphysis	0	19	0	15	34
Body	0	11	0	18	29
Angle	0	11	0	13	24
Ramus	0	2	0	1	3
Condyle	0	11	0	7	18
Dentoalveolar fractures	0	35	0	38	73
Symphysis, parasymphysis	0	1	0	0	1
Symphysis, angle	1	6	0	2	9
Parasymphysis, body	6	0	0	0	6
Parasymphysis, angle	17	0	0	0	17
Parasymphysis, ramus	1	0	0	0	1
Parasymphysis, condyle	19	0	0	2	21
Bilateral parasymphysis	8	0	0	0	8
Body, angle	2	1	0	0	3
Body, condyle	3	0	0	0	3
Angle, condyle	1	0	0	0	1
Bilateral angle	3	0	0	0	3
Bilateral condyle	9	0	0	0	9
Parasymphysis, angle, condyle	1	0	0	0	1
Parasymphysis, ramus, condyle	1	0	0	0	1
Total	72	97	12	96	277

it has been our observation that patients provide misleading information under unfavorable influences. As a result, it compels us to recheck for coexisting clinical signs and etiology to confirm the exact nature of the case presented and modify our line of treatment on a later date. Although various statistics pertaining to mandibular fracture are available from worldwide studies,^[3] this study attempts to find a correlation between associated factors to reach a precise diagnosis from the information provided by



Graph 2: Anatomical distribution of mandibular fractures

Table 3: Association between site of fractures and treatment done

Site of fracture	Treatment done		Total
	Closed method	Open reduction and internal fixation	
Symphysis	3	9	12
Parasympphysis	11	23	34
Body	11	18	29
Angle	14	10	24
Ramus	3	0	3
Condyle	17	1	18
Dentoalveolar fractures	70	3	73
Symphysis, parasympphysis	0	1	1
Symphysis, angle	1	8	9
Parasympphysis, body	0	6	6
Parasympphysis, angle	3	14	17
Parasympphysis, ramus	0	1	1
Parasympphysis, condyle	5	16	21
Bilateral parasympphysis	0	8	8
Body, angle	2	1	3
Body, condyle	0	3	3
Angle, condyle	0	1	1
Bilateral angle	2	1	3
Bilateral condyle	8	1	9
Parasympphysis, angle, condyle	0	1	1
Parasympphysis, ramus, condyle	0	1	1
Total	150	127	277

the patient as well as our observation of the clinical condition, in turn resulting in improved patient management.

Age

In our study, the peak incidence of mandibular fractures

was seen in the age group of 21–30 years (41.2%) which is consistent with previous reports.^[3,4,8-12]

Furthermore, in both males and females, the same peak age group (21–30 years) was affected, and this corresponds to previous findings.^[7,8] In this study, the least affected age range was 10 years or below (3.2%), followed by the age range of 61 years or above (4.7%).

Youth are most commonly affected because their involvement in the society and outdoor activities is more than other age groups. Hence, they are more prone to trauma by means of various physical activities, reckless driving, alcohol abuse, involvement in interpersonal violence, and participation in different sports activities.^[4,6] Children of 6 years of age and below are generally under parental care and hence that age group is refrained from sustaining severe injuries. Furthermore, the elasticity of bones makes them less susceptible to fracture. On the other hand, individuals above 60 years have comparatively less exposure to the outside world, who live a peaceful and disciplined life.^[6]

Mandibular fractures have been reported in all age groups (ranging from small kids^[8] to people of 95 years^[13]). Our data are in support with this observation as we had patients of 5 years of age to 78 years (39.5 years).

Gender

Male preponderance (80.1%) was observed in our study which is similar to results of other studies.^[1,6,7] The male-to-female ratio in our series was 4.03:1 and it is in line with other studies.^[4,8,14]

The involvement of men in the majority of the fractures may be due to their more outdoor participation and higher level of physical activity as they continue to be the prime wage earner of the family. Furthermore, they are more involved in traffic accidents or altercations as well.^[8,15]

Etiology

There is a striking contrast in the etiology of mandibular fractures both in developed and developing countries. The most common causative factor in developing countries is road traffic accidents.^[3,8,12,15]

In our study, road traffic accident (47.7%) was the most frequent cause which is in accordance with other studies.^[6,15-17] This may be due to rash driving and overspeeding, below par roads, unwilling to use safety measures such as helmets or seatbelts, inadequate implementation of traffic rules, drunken driving, increased use of motor vehicles by minors, poor maintenance of vehicles, etc.^[3,6,8,15] In patients of age range 21–30 years, road traffic accidents are common cause because of irresponsible and aggressive driving or they may want to boast also [Table 1].

The second most common cause was falls (31.0%). This may be due to variety of reasons such as occupations at elevated heights or other hazardous working conditions and falls from stairs or on wet/slippery uneven surfaces and bathrooms. In certain patients, falls may be due to medical conditions, decreased tendency to travel by roads, lack of geriatric care, or due to senility. Furthermore, in geriatric patients, bones become more brittle and have a susceptibility to injuries even after minor falls.^[17] This condition becomes worse with poor muscular control and bodily response.

The third next cause is assault (18.4%). Assault may be due to aggressive behavior, peer pressure to perform better, unemployment, social inequality, alcohol or drug abuse, and low standard of living. Drunk driving or assault due to alcohol consumption is less in Gujarat because of policy of prohibition.^[18]

In our study, clinical observation shows that road traffic accident is the most common cause in males (47.2%), whereas in females, it is road traffic accident (49.1%), followed by assault and fall (25.4%). In this study, the incidence of assaults and falls is almost the same which is disbelieving because physical abuse is often underreported.^[4,8] Patients fear to report physical abuse because of which true picture cannot be studied by a treating surgeon, and this can cause a problem in the future in relation with medicolegal cases.

Anatomical distribution of fracture

The fracture site prominent in our study was dentoalveolar fractures (26.4%). This is in contrary to other study groups.^[6,15] There are other study groups which show contrary results to our study such as Adi *et al.*^[9] reported body as the most common whereas Dongas and Hall^[19] and Ogundare *et al.*^[7] showed angle; Brasileiro and Passeri^[20] stated condyle as the most common site of fracture. Coronoid was the least common type in our study which is similar to few studies^[21] [Graph 2].

On the basis of cause, the distribution of fractures may be linked to factors related to the mechanism of the injury. The direction and magnitude of impact force, the kind of object

leading to impact, anatomy of the site, prominence and physical characteristics of the mandible, direction of the victim's head position, and status of occlusion are responsible for the wide-ranging clinical outcomes.^[21,22] However, in our study, no statistical significance was found between etiology and distribution of fractures.

However, because of improper, false, and partial history given by the patients due to unfavorable circumstances, diagnosis can be affected and eventually the treatment also loses its potential to be effective at an early stage. As a result of this, some patients who may require simultaneous psychological treatment are deprived of it as in cases of domestic violence or child abuse.

Frequency of single and multiple fractures

We found that of total patients, single fractures were found in 193 patients (69.7%) and multiple fractures were seen in 84 patients (30.3%). Among multiple fracture sites, in our study, the most common combination was parasymphysis and condyle (7.6%) which is similar to studies done by Natu *et al.*,^[6] Chrcanovic *et al.*^[8] However, it is contrary to many studies^[16,14,19] that showed the most common combination to be parasymphysis and angle; Ogundare *et al.*^[7] have reported body with angle.

Management

The aim of treating mandibular fractures is to establish a stable occlusion, preserve normal mandibular arch form, restore mandibular function, retain the symmetry of the face, and avoid the advancement of a developmental disorder. Treatments generally vary according to fracture type, number and location, surgeon preferences, patient characteristics (age, dental profile, and choice of treatment), etc., There are many treatment options available such as intermaxillary fixation, open reduction and internal fixation, closed treatment with external fixation, and treatment with Kirschner wire.^[14,23]

In this study, 127 patients underwent open reduction and internal fixation which involved the use of miniplates, monocortical screws or transosseous wiring, or combination of these. Conservative management was followed in 150 patients, which included the use of arch bars, Ivy loops, and intermaxillary fixation.^[3] Closed reduction was done bearing in mind the age of the patient, displacement of fracture, medical conditions, and patient's preference.

CONCLUSION

Mandible, in the human face, has functional and esthetic importance, and if fractures related to the mandible remain undiagnosed or inaptly treated, then it may lead to severe cosmetic, functional, and psychological consequences to the patients. Although demographic data related to mandibular fractures are extensively studied in the past, this study correlates the few factors associated with mandibular fractures that were reported to a tertiary hospital in Gujarat, India. This correlation will at least give an idea to the treating oral

and maxillofacial surgeon or private dental practitioner at an institute level as well in private practice in terms of exploring the causes in cases of improper and partial history given by the patient, for the precise diagnosis and treatment of the fracture as well as in maintaining medicolegal records.

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Conflicts of interest

There are no conflicts of interest.

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